

# REVIEW OF SUNKEN GILLNET SPECIFICATIONS USED IN THE GROUND FISH FISHERIES

REPORT TO THE ALASKA  
BOARD OF FISHERIES



by

William R. Bechtol

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## ABSTRACT

Following recent biological or economic declines in many traditional Alaskan fisheries, such as salmon and shellfish, there has been increased interest in using sunken gillnets for groundfish fisheries. Sunken gillnets may be fished under the authority of an Alaska Department of Fish and Game permit which may specify time and area fished, gear, operating requirements, and completion of a log book. Permits are issued for groundfish fisheries in state waters of Prince William Sound, the Central Gulf of Alaska, and the Aleutian Islands management areas. Primary target species have included Pacific cod, lingcod, rockfish, sablefish, and shark. Concerns with the use of sunken gillnet have centered on the bycatch of non-target, often high-value, species, the loss of gear which may continue to ghost-fish, and the preemption of existing fishermen in fully allocated fisheries. Sunken gillnet fisheries off Massachusetts, Washington, and Southeast Alaska are also discussed.

**KEY WORDS:** Groundfish, sunken gillnet, bycatch, ghost fishing, preemption.

## INTRODUCTION

With recent stock or economic declines in many traditional fisheries, such as shellfish and salmon, an increasing number of Alaska fishermen have pursued groundfish as a primary or supplemental income. The increased effort in both state and federal waters has resulted in mid-year closures of groundfish fisheries that historically occurred year-round. These quota closures have been 1) species-based, or 2) gear-based due to prohibited species mortalities. As annual closure patterns have developed, fishermen have sought other gears or fisheries to extend the fishing season. Although harvest allocations for most groundfish (e.g, Pacific cod, sablefish, and slope rockfish) have become fully utilized by existing longline, trawl, pot, and jig fisheries, an increasing number of fishermen have expressed interest in the use of sunken gillnets.

Sunken gillnets have been used extensively along the Atlantic coast and off the coast of California (south of 38° N lat.). As an experimental fishery, sunken gillnets have also been used off the Washington coast and previously in Southeast Alaska.

Within territorial waters off the coast of Alaska, sunken gillnet fisheries have occurred under the authority of an Alaska Department of Fish and Game (ADF&G) permit. Currently, permits are only issued for groundfish in Prince William Sound, the Central Gulf of Alaska (located between 147°W and 159°W longitude and excluding the interior of Cook Inlet), and the Aleutian Islands area located south of 55°N and west of 170°W (Figures 1 and 2). Permits for the Central Gulf of Alaska are further designated as applying to (1) the North Gulf - state waters of the Central Gulf of Alaska located north of Cape Douglas and west of 147°W longitude, and excluding Prince William Sound and Cook Inlet; or (2) the Westward Region - here includes state waters of the Central Gulf of Alaska located south of Cape Douglas and east of 159°W longitude. Sunken gillnet permits may specify time and area fished, gear, operating requirements, and completion of a log book. In general, sunken

gillnet fisheries have been loosely regulated to allow fishermen to develop gear.

Management concerns about sunken gillnet fisheries have centered on 1) the bycatch of non-target organisms, and 2) the loss of gear which may continue to fish. Attempted solutions for these concerns have revolved around 1) mesh size, 2) depth between leadline and corkline, 3) distance fished off the bottom, 4) net length, 5) gear monitoring, 6) area fished, and 7) time-of-year fished. This report is a compilation of several presentations in 1991 and 1992 to the Alaska Board of Fisheries during a review of sunken gillnet fisheries off the coast of Alaska. An additional factor with the expansion of the sunken gillnet fishery is the potential preemption of permit holders in established groundfish fisheries.

## MANAGEMENT CONSIDERATIONS

### *Target Fishery*

Target species in sunken gillnet fisheries off the Alaska coast have included Pacific cod, lingcod, rockfish, and sablefish. In the late 1970's, several permits listed salmon shark (18 inch mesh size) as a target species (unpublished data). The major target emphasis has varied with area, season, and market conditions. Fishing areas are typified by rugged coastline, with steep bottom slopes, an abundance of reefs, exposure to open ocean, and inclement weather, particularly during the winter. Tidal currents can be substantial, particularly around points and passages.

## *Bycatch*

Bycatch is defined in this report as the incidental capture of non-target species which are retained as well as the mortality of discarded species. Bycatch is dependent upon the species and size composition of fishes present in the area being fished, and the gear selectivity for particular species or fish sizes. While size composition is not considered to be a conservation issue at this time, it could become an issue in the future if markets become size selective and fishermen begin to higrade their catch by discarding smaller, less valuable, size classes of fishes. Some processors already pay on a sliding scale based on fish size (personal observation).

The North Pacific Fisheries Management Council establishes bycatch rate standards which specify unacceptable levels of prohibited species bycatch for federal waters fisheries. The 1992 standards applied to halibut bycatch in fixed gear fisheries for Pacific cod was 3% (by weight) in the Bering Sea/Aleutian Islands and 5% (by weight) in the Gulf of Alaska (National Marine Fisheries Service News Release, February 3, 1992). Although bycatch standards do not exist for many species and area combinations, such as crab in the Gulf of Alaska, the incidental capture of these species is disconcerting (Blackburn 1992). Concern has also increased over the sunken gillnet capture of non-harvested species such as birds and marine mammals (Alaska Department of Fish and Game 1992; Barrowman 1986).

Annually increasing catches of non-target species, particularly halibut, crab, salmon, and sablefish, was a major reason for the elimination of sunken gillnet from Southeast Alaska groundfish fisheries (B. Bracken, Alaska Department of Fish and Game, Petersburg, personal communication). Halibut bycatch by sunken gillnets in Southeast increased from 0.5% in 1979 to 8.7% in 1981 and these halibut averaged 25% mortality (Eastwood 1981). Mortality was 10 to 30% for crab, and 100% for salmon.

To reduce halibut and crab bycatch, most sunken gillnet permits have required that the



webbing be fished at least 18 inches off the bottom. However, B. Bracken (Alaska Department of Fish and Game, Petersburg, personal communication) has suggested that most of the halibut and crab bycatch in Southeast resulted from the gear being forced into the substrate by currents, so the 18 inch specification had limited success. Another suggested option is to limit the length of net fished in each set. This assumes that shorter nets could be set tighter and would be less likely to entangle the substrate and capture benthic organisms.

A minimum mesh size (e.g., 5½ to 6 inches) has been specified in some sunken gillnet fisheries to reduce salmon bycatch (Table 1). For example, early Cook Inlet permits required meshes larger than 3½ inches. However, the mesh actually used in most groundfish fisheries has been substantially larger than the specified minimum. Most salmon bycatch has generally been king salmon, which often overlap in size with Pacific cod. Therefore, it may be difficult to reduce salmon bycatch through mesh requirements. In Southeast, the maximum net depth (i.e., distance between the corkline and the leadline) was restricted under the assumption that such a net would fish closer to the substrate and reduce the potential for salmon bycatch. However, net depth restrictions probably had limited effects because of the difficulty in stretching a net tight enough to avoid having the net bow away from the substrate due to currents. Ultimately, salmon bycatch is probably related more to fishing locality and time of year than to gear. Thus, the use of sunken gillnet in state waters off Alaska has generally been restricted to the winter months to reduce the potential for salmon bycatch.

Few studies have compared the bycatch of sunken gillnet to other gears in a specific area and target fishery. Klein (1986) did determine that gillnets were more selective than trawl gear but less selective than longline or trap gear in sablefish fisheries off the Washington coast.

## *Lost Gear*

A major concern with sunken gillnets is the potential for lost gear to continue to catch fish, referred to as ghost fishing. The duration of ghost fishing varies substantially with bottom topography and net configuration (Way 1977). Studies off Canada and New England documented catches of Atlantic cod, dogfish, lobster, skate, and crab in ghost nets (Carr et al. 1985; Cooper et al. 1988). A fisherman reporting the recovery of a gillnet lost for a month off the Washington coast estimated 1,200 to 1,500 sablefish were in the net, with 60 fresh enough to be marketed (Barrowman 1986). It is anticipated that some gillnet loss will occur with any extended sunken gillnet fishery, that such loss will increase as effort increases, and that some lost gear will continue to fish. In the Gulf of Maine, a sunken gillnet fishery has been established since the late 1800's. A 1984 to 1986 study using submersibles and ROV's in this area estimated 2,497 ghost gillnets to be in the 64 nm<sup>2</sup> study area (Cooper et al. 1988).

Sunken gillnet permits generally have stipulations to reduce the ability of lost gear to continue to catch fish. Federal permits off Washington required biodegradable line attaching the corkline to the webbing, while most other areas, including Alaska, require biodegradable line between the leadline and the webbing. The intent of ADF&G biodegradable requirements is to allow the corkline and webbing to break free of the substrate and wash up on a beach instead of continuing to fish. However, Atlantic coast studies suggest it is difficult to make lost gillnets unfishable because the lines and webbing tangle and limit the ability of the corkline to float free (Carr et al. 1985; Carr 1988).

The probability of losing gear can be expected to increase with the length of individual sections of gear (i.e., shackles). Thus, another approach to reducing the potential for gear loss is to limit the gear allowed either in total or in a single shackle. While permits for various fisheries have specified maximum net lengths ranging 25 to 3,000 fathoms to unlimited, the reduction of gear conflicts has most often been cited as the reason for gear

length limitations. In the North Gulf and Westward Region, fishermen have rarely fished the maximum allowable gear when a maximum has been specified and most fishermen have fished shackles shorter than 500 to 600 fathom. While longer gear may catch more fish, longer gear is also more difficult to set and retrieve.

Sunken gillnet permits often specify how closely the gear must be attended in order to reduce the potential for gear loss from rapidly changing weather or gear conflicts. Previous ADF&G permits required the gear to be "closely attended", while federal permits for the Washington coast required the fishing vessel to "remain with the gear at all times..." (Barrowman 1986). Cooper et al. (1988) suggested that most of the recent gillnet losses in the Gulf of Maine are related to gear conflicts (e.g., trawl or longline gear being fished across sunken gillnets). It has also been suggested that many gillnet losses have been related to inexperienced fishermen, particularly in developing fisheries (Barrowman 1986; Cooper et al. 1988).

### *Preemption*

Fishery resources are finite, and introduction or expansion of one user group or gear type when the target resource is fully allocated may result in preemption of existing user groups, user group conflicts, and localized resource depletions. Conflicts resulting from the preemption of existing user groups by expanding sunken gillnet fisheries have been documented off Texas, Louisiana, and Rhode Island (New England Fishery Management Council, staff memorandum, 25 August 1982). The sunken gillnet fisheries along the Central Gulf of Alaska primarily target Pacific cod. Harvest allocations for all gear types for the Pacific cod fisheries in this area have declined about 15% annually since 1989 (J. Gharrett, National Marine Fisheries Service, Juneau, personal communication). Increased effort in the Pacific cod fisheries has also resulted in shorter seasons. An expanding sunken gillnet fishery would compete with and could displace some existing permit holders, as well

as exacerbate the shortening of the fishing seasons.

## AREA SPECIFIC FISHERIES

The development of sunken gillnet fisheries, including the gear and operating requirements placed on these fisheries, has varied widely with target species, bycatch potential, and the degree of resource allocation. Examples of some of the better documented sunken gillnet fisheries are provided below.

### *Massachusetts*

Sunken gillnets have been used in the Gulf of Maine since the late 1800's. These nets were marked with buoys and radar deflectors at each end. The net consisted of a corkline and a leadline separated by one fathom of monofilament webbing. Mesh size varied with target species (e.g., Atlantic cod, flatfish, lobster, or dogfish shark; A. Carr, Massachusetts Division of Marine Fisheries, personal communication) but 6-inch mesh was commonly used for cod fishing. In the early 1980's, each vessel fished 5 to 6 sets, each set being 500 to 600 fathoms in length. Regulations for 1991 specified a minimum mesh size of 6 inches, a maximum net length of 400 fathoms, and a maximum vessel size of 90 feet. The literature provides little information on catch composition or rates. Carr (1988) described Atlantic cod landings of 3,256 lbs/wk, but did not indicate if this was typical. Lost gear has become a concern in recent years and Carr (1988), Carr et al. (1985), and Cooper et al. (1988) have studied this problem in the Gulf of Maine.

### *State Waters off Washington*

Sunken gillnet fisheries in state waters off Washington during the 1940's to 1970's were sporadic, driven by short-term markets, and primarily targeted Pacific cod or dogfish shark. Pedersen (1980) described the sunken gillnets used in Puget Sound during 1974 to 1976 as 12-thread cotton webbing (often treated), not longer than 1000 ft (167 fathoms), with not less than 4½ inch mesh (Table 1). Webbing legal for salmon could be used for dogfish from December 15 to March 31, provided that the net was not more than 30 meshes deep and was tar dipped if a nylon mesh. Buoys of unattended nets were required to be marked with the operator's license number. A permit-only system was established in 1975 which restricted gear to 1000 ft of 25 mesh deep nylon webbing (most fishermen used 5 to 6 inch mesh), and a February 15 to April 14 season for Pacific cod.

Following permit modifications in 1976, fishermen in the spiny dogfish fishery were allowed up to six nets (most permit holders used four), not to exceed 3000 ft (500 fathoms) of webbing (nylon was allowed), 4½ inch minimum mesh size (most use 7 to 7½ inch), and 25 meshes maximum depth. The fishery was conducted throughout the year.

### *Federal Waters off Washington*

Fishing with sunken gillnets for sablefish in federal waters off Washington has occurred since 1980 under the authority of an Experimental Fishing Permit. Barrowman (1986) lists permit requirements including: 1) a May 1 to December 31 season; 2) a minimum of one trip, comprised of at least two overnight sets, each calendar month that fishing is permitted; 3) no sets may be made shallower than 90 fathoms, and written approval is required from NMFS to make sets shallower than 180 fathoms; 4) a maximum of 1600 fathoms of net may be

fished simultaneously; 5) a pole and flag, light, radar reflector, and buoy identifying the permit holder and having a unique set number to distinguish it from other sets under this permit must be placed at the terminal end of each set; 6) one shackle of test webbing must be included on one of the nets fished during each set; 7) mesh size is a minimum of  $5\frac{7}{8}$  inches for the commercial shackles and a maximum of  $5\frac{1}{4}$  inches for the test shackle; 8) a maximum of 25 meshes between the cork and leadline of each shackle; 9) attachment of the webbing to the cork line with untreated cotton twine no thicker than 36 thread; 10) buoy lines at least  $\frac{1}{2}$  inch in diameter; and 11) the vessel must remain with the gear at all times (Table 1).

Klein (1985) determined a June to October season was optimal for maximizing sablefish catch and minimizing the bycatch of lingcod and rockfish off Washington. Salmon bycatch did not appear to be a problem in sunken gillnet fisheries in federal waters.

### *Southeast Alaska*

For southeast Alaska (Bracken 1980; Eastwood 1981), permit requirements included: 1) webbing must not fish less than 18 inches off the bottom; 2) only bottomfish, excluding sablefish and halibut, may be retained; 3) buoys, marked with the vessel ADF&G number, must be attached at both ends; 4) "the gear must be closely attended and picked daily;" 5) an ADF&G observer may be placed aboard the permit vessel; and 6) logbooks may be required. Seasons were initially January to May, but were later shifted to November to March to decrease the incidental catch of spawning salmon.

When the fishery evolved in 1978, there were few gear restrictions. Surplus salmon gear was generally used, gear integrity was poorly maintained, and a unit of gear rarely lasted more than one week of fishing. Beginning in 1980, a minimum mesh size of 7 inches and a maximum net length of 400 fathoms was required for the Juneau area, and requirements for

other districts specified a 5½ inch minimum mesh and an aggregate length of 1,000 fathoms (Table 1).

Historically, gear in the Juneau area has ranged from 6¾ to 8¼ inch mesh, 10 to 25 meshes deep, and 35 to 200 fathoms long. Gear in other districts varied from 5 to 10 inch mesh monofilament, 10 to 30 meshes deep, set in lengths of 50 to 500 fathoms (averaging 367 fathoms). Vessels fished five to six sets of gear per day, with set duration averaging 7.3 hrs in the Ketchikan area, and generally 18 to 24 hrs in other areas.

Production in the Southeast Alaska sunken gillnet fishery declined from 45 cod per 100 fathoms of net in 1979 to 5 cod per 100 fathoms in 1982. Observer and logbook documented catch rates of prohibited species (e.g., halibut, salmon, crab, and sablefish) increased from 3% in 1979 to 15% in 1981. Mortality was estimated at 100% for king salmon, more than 50% for sablefish, 10 to 30% for crab, and 25% for halibut under 10 lb.

### *North Gulf*

In 1977, the Alaska Board of Fisheries established a sunken gillnet fishery in the territorial seas of Cook Inlet's Outer and Eastern Districts. This area was later redesignated as a portion the Central Gulf of Alaska for the purpose of groundfish management and is here identified as the North Gulf. Through 1991, 32 permits were issued, but only 12 vessels fished and made 23 landings for 17,980 lb of groundfish (Table 2; unpublished data). There was little cooperation from fishermen in documenting bycatch, and only four logbooks were returned to the Department. Due to the sporadic effort, no trends have been noted. Generally, gear has ranged from 160 to 600 fathoms and often involved nets comprised of several different mesh sizes (Table 3).

### *Prince William Sound*

The sunken gillnet fishery in Prince William Sound was established in 1985 with a September 15 to April 14 open season. Since 1985, nine permits have been issued, and three vessels actually fished, making eight landings for a total of 31,074 lb (Table 2). Logbooks were received from two of these vessels.

### *Westward Region*

The sunken gillnet fisheries in the territorial seas of the Kodiak and Aleutian Islands (south of 55° N. lat. and west of 170° W. longitude) Areas were established in 1984 with open seasons from November 1 to April 31 annually. From 1987 through October 1991, 17 permits were issued (Table 2). However, only seven of the 16 vessels which delivered catches from sunken gillnets actually had permits. The 51 documented landings for sunken gillnet gear totaled 161,830 lb of groundfish. The limited logbook data indicated the target species was Pacific cod, and that bycatch consisted of sole, halibut, Tanner crab, sculpin, and king salmon also reported (Alaska Department of Fish and Game 1992; Blackburn 1992).

## **CONCLUSION**

Sunken gillnet fisheries have been documented with significant bycatches of non-target, often high-value species, such as crab, halibut, and salmon, as well as birds and marine mammals. Bycatch mortality can approach 100%, depending upon the species, the degree of



entanglement, and currents. The Alaska coastline tends to be rugged with steep bottom slopes, an abundance of reefs, and substantial tidal currents. These conditions not only make it difficult to set gillnets which fish off the bottom and do not entangle the substrate, but also contribute to lost gear which continues to fish.

While some fishermen have reported an ability to limit bycatch and gear loss, most fishermen, especially inexperienced individuals, will encounter these problems at some time. The potential for problems may be reduced by: 1) restricting gear configurations, 2) requiring that gear be constantly attended, and 3) restricting fishing times and areas.

The original Alaska Board of Fisheries proposals intended that small boat fisheries using sunken gillnets would develop in the winter months. However, only sporadic participation has occurred in these fisheries. While there has been renewed interest in the use of sunken gillnet to harvest groundfish, it is unlikely that the current economic concerns of the fishing industry will be resolved by the expanded use of sunken gillnets. Interest in this gear may increase further as gear and species based management, particularly with respect to individual fishing quotas (IFQ's), is intensified in federal waters. Continued expansion of the sunken gillnet fleet could displace participants in existing groundfish fisheries.

The continued expansion of the sunken gillnet fishery should depend on the ability of fishermen to limit bycatch and lost gear. The ADF&G currently lacks adequate funds to monitor and manage existing sunken gillnet fisheries. If sunken gillnet use expands, the ADF&G would need to reprogram monies dedicated to other fisheries in order to manage the sunken gillnet fishery, effect the logbook program, address enforcement issues, and increase onboard observer coverage.

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Table 1. Some sunken gillnet specifications for several Atlantic and Pacific coast groundfish fisheries.

AREA	MASSACHUSETTS	WASHINGTON STATE <sup>a</sup>	WASHINGTON FEDERAL	SOUTHEAST ALASKA	CENTRAL GULF
TARGET SPECIES	VARIED	COD	SABLEFISH	COD	COD
MESH (inches)					
MINIMUM	6	4½	5⅞ <sup>b</sup>	5½	3½
USED	6	5-6	ND	5-10	3½-18
LENGTH (fathom)					
MAXIMUM	400	167	1,600	400-1,000	NONE <sup>c</sup>
USED	500-600	ND	ND	50-500	25-3,000
DEPTH (meshes)					
MAXIMUM	ND	25	25	10-30	NONE

<sup>a</sup> Spiny dogfish fishermen can use up to 500 fathom, and most use 7-7½ inch mesh.

<sup>b</sup> A test shackle with a maximum of 5¼ inch mesh is required.

<sup>c</sup> A maximum length of 3,000 fathoms was implemented in 1992.

Table 2. The number of permits issued, vessels that fished, landings, and pounds (round weight) of groundfish harvested by sunken gillnets in the Central Gulf of Alaska, Prince William Sound, and Westward Region Management Areas from 1977 to October 1991.

NORTH GULF									
YEAR	PERMITS ISSUED	VESSELS FISHED	LAND- INGS	ROCK- FISH	SABLE- FISH	PACIFIC COD	LING- COD	OTHER	TOTAL
1977	0	0	0						0
1978	10	3	3	171		3,468			3,639
1979	2	2	2	2,246			13	371	2,630
1980	3	0	0						0
1981	1	0	0						0
1982	0	0	0						0
1983	0	0	0						0
1984	2	2	1	752			180		932
1985	1	0	0						0
1986	1	0	0						0
1987	7	4	13			3,321	4,154	878	8,353
1988	2	0	0						0
1989	0	0	0						0
1990	1	0	0						0
1991	0	2	4	37		2,109		280	2,426
Total	32	12	23	3,206	0	8,898	4,347	1,529	17,980

PRINCE WILLIAM SOUND									
YEAR	PERMITS ISSUED	VESSELS FISHED	LAND- INGS	ROCK- FISH	SABLE- FISH	PACIFIC COD	LING- COD	OTHER	TOTAL
1985	1								0
1986	1								0
1987	1	1	2			18,522			18,522
1988	0								0
1989	0								0
1990	2								0
1991	4	2	5	4		12,544	4	0	12,552
Total	9	3	7	4	0	31,066	4	0	31,074

WESTWARD REGION									
YEAR	PERMITS ISSUED	VESSELS FISHED	LAND- INGS <sup>a</sup>	ROCK- FISH	SABLE- FISH	PACIFIC COD	LING- COD	OTHER	TOTAL
1987	5	6	15			55,074		402	55,476
1988	10	9	35	152		96,344		7,690	104,186
1989	0	1	1			2,169			2,169
1990	2								0
1991	0	0	0						0
Total	17	16	51	152	0	153,587	0	8,092	161,831

<sup>a</sup> Nine of the sixteen vessels making landings from the Westward Region lacked sunken gillnet permits.

Table 3. Sunken gillnet length and mesh size listed on permits for Prince William Sound and the Central Gulf of Alaska (including Westward Region).

LENGTH (fathoms)	MESH SIZE (inches)								VARIABLE <sup>a</sup>
	3.5	5	5.5	6	6.5	7	7.5	8	
200		2	3	8	3	6	1		5
400		5		3	1			1	5
600		1		2	1				3
800					1				1
1,000					3				4
1,500									2
2,500	1								
3,000									1

<sup>a</sup> Nets comprised of more than one mesh sizes are listed as a variable mesh for the total aggregate length of webbing listed on the permit. For example, a permit listing 50 fathoms of 5½ inch mesh, 100 fathoms of 6 inch mesh, and 50 fathoms of 6½ inch mesh is listed above as a 200 fathom, variable mesh net.

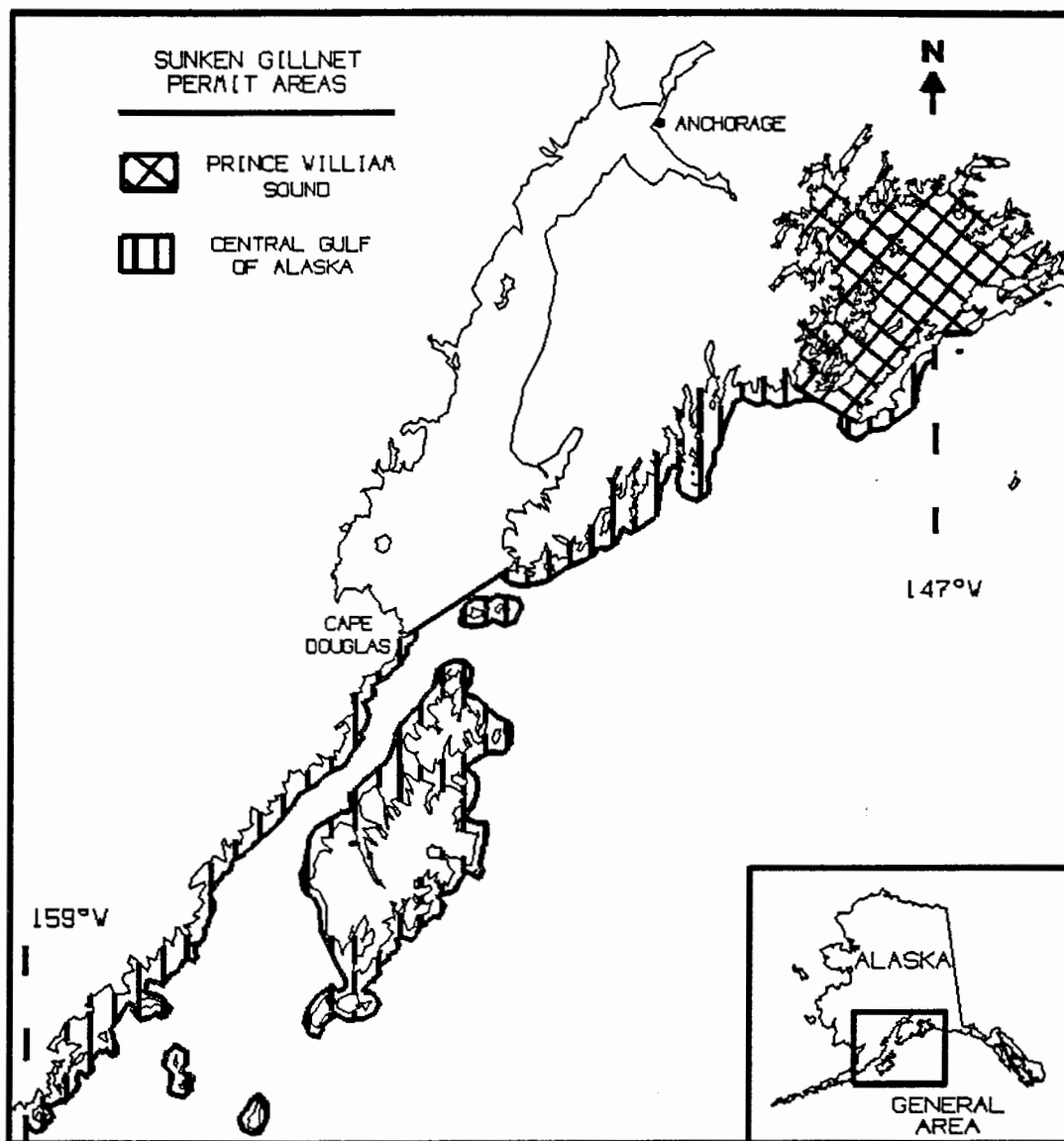


Figure 1. Sunken gillnet permit areas for groundfish fishing in Prince William Sound and state waters of the Central Gulf of Alaska.

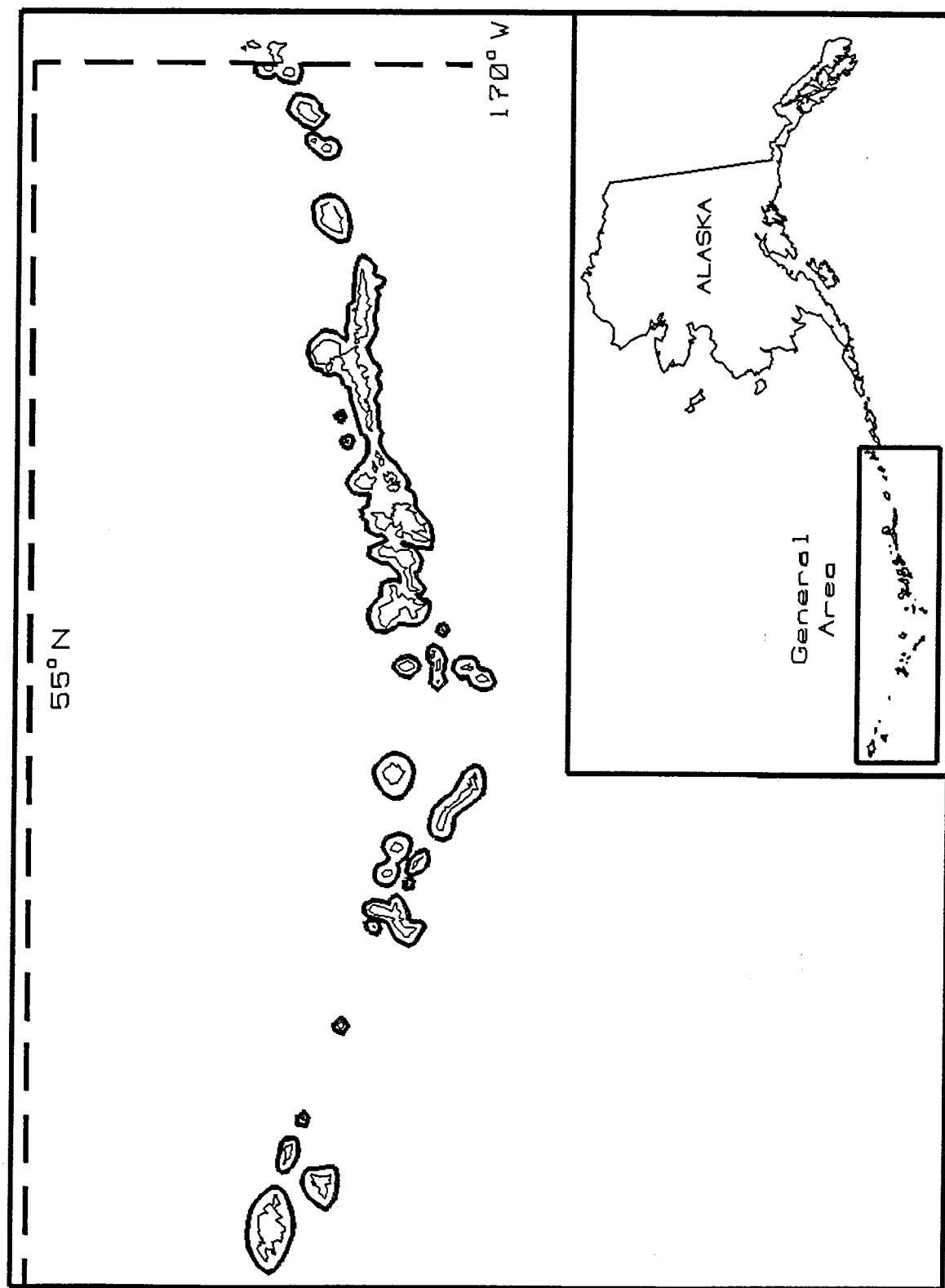


Figure 2. Sunken gillnet permit Area 4 for groundfish fishing in state waters of the Bering Sea-Aleutian Islands management area.

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